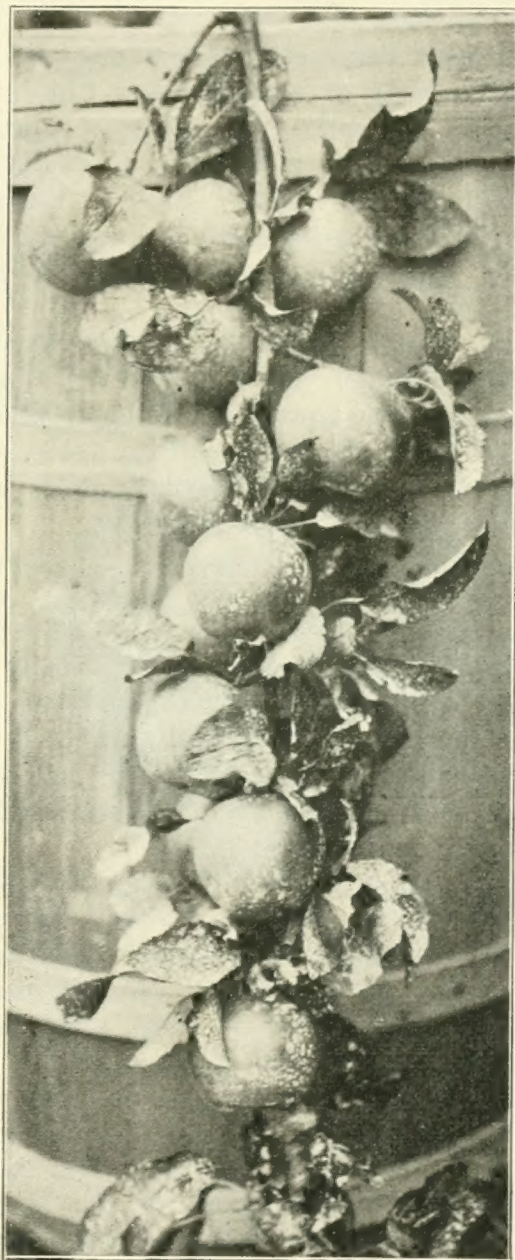
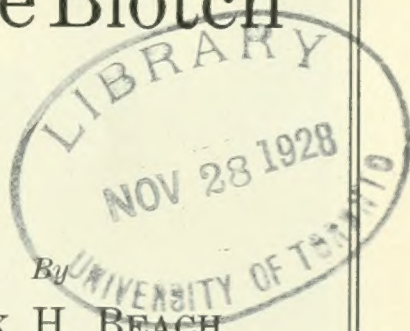




A branch of perfect fruit from a badly blotted tree that received special sprays. Note spray on fruit and leaves. This was applied 84 days before photograph was taken.

The Control of Apple Blotch



By **FRANK H. BEACH**
Department of Horticulture
Ohio State University

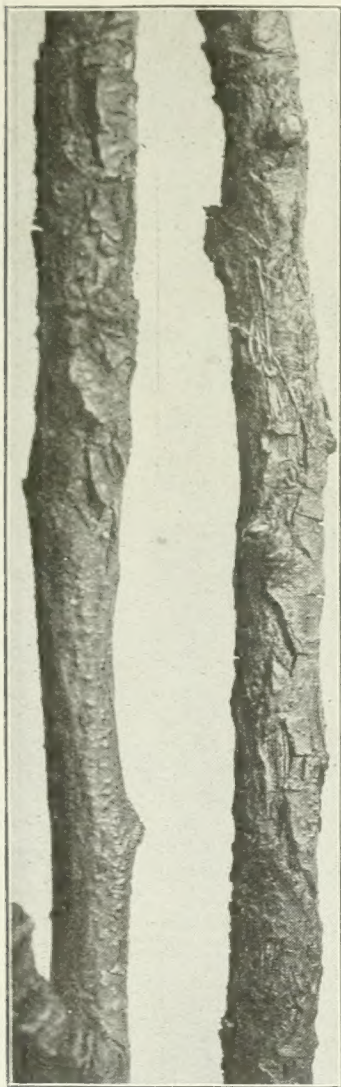
The Ohio State University, Cooperating with the United States Department of Agriculture.
Agricultural College Extension Service, H. C. Ramsower, Director, Columbus, Ohio.
FREE—Cooperative Agricultural Extension Work—Acts of May 8 and June 30, 1914.

The Control of Apple Blotch

By F. H. BEACH

Department of Horticulture

Apple blotch has become one of the most destructive apple diseases in many orchards of southern and more particularly of southwestern Ohio. It is spreading rapidly northward and eastward. Already it has become a problem of state-wide magnitude to apple growers. This publication is designed to give practical information on apple blotch and its control, based on the results of demonstrations conducted jointly by the Agricultural College Extension Service of the Ohio State University, cooperating with county agricultural agents and apple growers.



Twigs showing apple blotch cankers.

The Fungus.—Apple blotch is a fungus growing on the fruit, foliage, and twigs of the apple. It is seldom a serious trouble on foliage, where it is evidenced by small grayish-white spots. On the fruit, twigs, and fruit spurs it becomes extremely serious on susceptible varieties.

On the fruit, the disease first makes its appearance as a small brown spot which rapidly enlarges, showing a ragged border of radiating splashes. Severe infections are followed by a cracking open of the apple toward the end of the growing season. Apples badly infected in this manner become worthless for any purpose, even for cider stock, as the flesh of the apple dries up into a spongy mass.

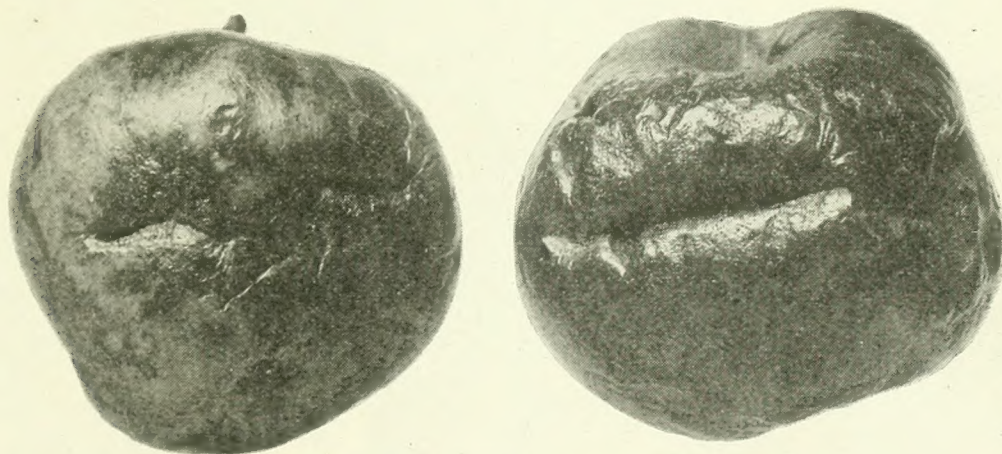
On the fruit spurs, terminal twig growths, and water sprouts the disease develops typical cankers. On extremely susceptible varieties, such as Duchess of Oldenburg, Northwestern Greening, and Mann, infected fruit spurs are often seriously weakened or killed outright by cankers. Badly cankered trees lose an immense amount of bearing surface in this manner and become very unproductive. Pathologists who have investigated the life history of the blotch fungus report that the disease holds over winter in these cankers. It is their conclusion that little, if any, spread of the disease from year to year occurs from mummied fruits and diseased foliage. A spray treatment which will prevent the formation of new cankers and gradually eliminate the old ones, at the same time keeping the apples and foliage free from infection, is the basis of

success in blotch control. Such a plan was attempted in the demonstration work, some of which is reported in this bulletin.

These demonstrations were conducted during the seasons of 1918 and 1919 in Clermont, Hamilton, Warren, Scioto, and Washington counties.

Susceptibility of Varieties.—Varieties vary greatly in susceptibility. Apple blotch usually enters an orchard by first appearing on trees of the most susceptible varieties and gradually spreads from these to the more resistant sorts. By watching for the appearance of blotch on the most susceptible trees in the orchard, and giving these trees special spray treatment when blotch is noticed, the disease can be kept under control. Following is a classified list of some of the more commonly grown varieties with reference to their susceptibility to apple blotch.

<i>Very Susceptible</i>	<i>Susceptible</i>	<i>Rather Resistant</i>
Duchess of Oldenburg	Ben Davis	Grimes
Stark	Gano	Winesap
Smith Cider	Yellow Transparent	Stayman
Mann	Rome Beauty	Delicious
Northwestern Greening		Jonathan
Maiden Blush		
Missouri Pippin		



A severe infection of apple blotch.

DEMONSTRATION WORK

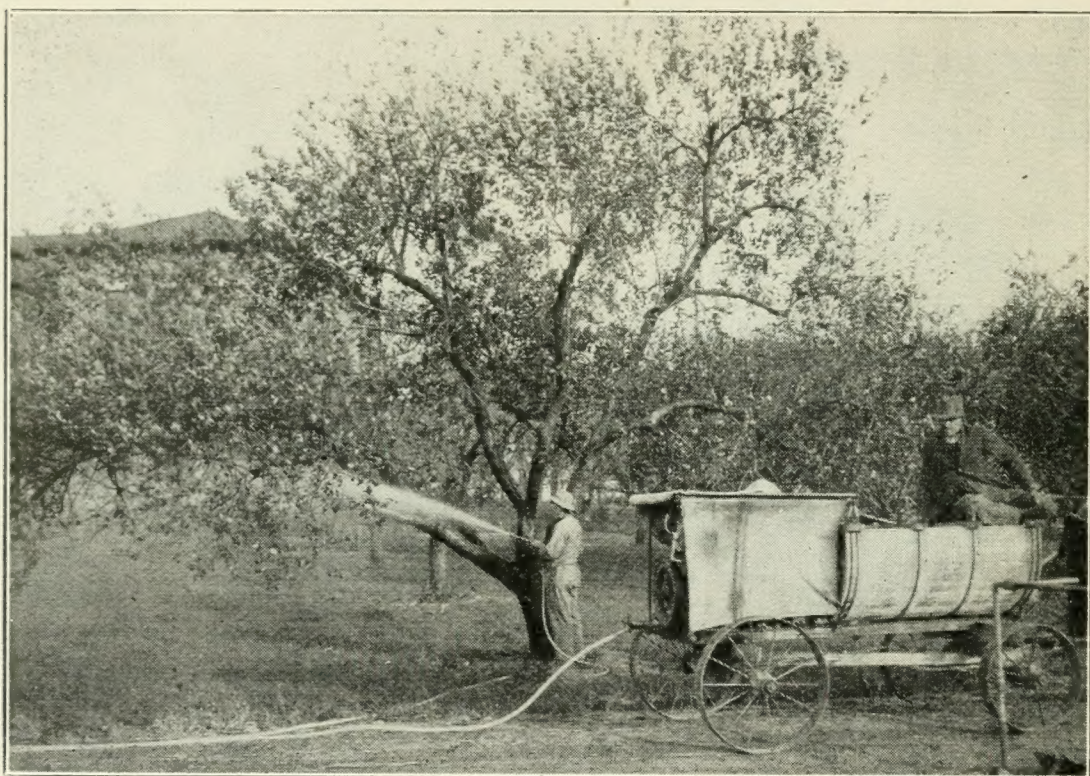
Material.—Bordeaux mixture prepared by the following formula was successfully used in the spraying demonstrations for blotch control.

3 pounds bluestone (copper sulfate)
 5 pounds hydrated lime
 50 gallons water

For convenience in mixing, the bluestone was prepared in stock solution about a day beforehand. A given weight of bluestone, for example 50 pounds, was placed in a sack and hung in a barrel of water so that the bottom of the sack was suspended in the top of the water. (Bluestone dissolves rapidly in this way.) A few less gallons of water were put into the barrel than there were pounds of bluestone in the sack. After the bluestone had dissolved water was added to the barrel to make the number of gallons of bluestone solution equal the number of pounds of bluestone dissolved—in this case 50 gallons. Then each measured gallon of well mixed solution contained 1 pound of bluestone. (If desired a stock solution can be prepared containing 2 or even 3 pounds of bluestone to the gallon.)

The recommended method for mixing bordeaux is to dilute the bluestone and the lime in separate wooden vessels so that each vessel contains half the quantity of total bordeaux desired. The dilute bluestone solution and the dilute lime solution are poured together evenly and allowed to mix in a stream as they are strained into the spray tank.

In the demonstration work bordeaux was prepared in the spray tank in a somewhat more convenient manner. The spray tank was first filled with water to about two-thirds the quantity of bordeaux needed. The necessary amount of bluestone water from the stock solution was then measured into the tank. In a separate vessel the required weight of hydrated lime was mixed with water to make a rather dilute solution—in amount almost equivalent to the remaining one-third needed. The agitator in the spray tank was then started, after which the dilute solution of hydrated lime was strained



First step in spraying a tree for blotch, the spray directed outward and upward covers the under and inside surfaces in the interior of the tree and the "inside cheeks" of the apples.

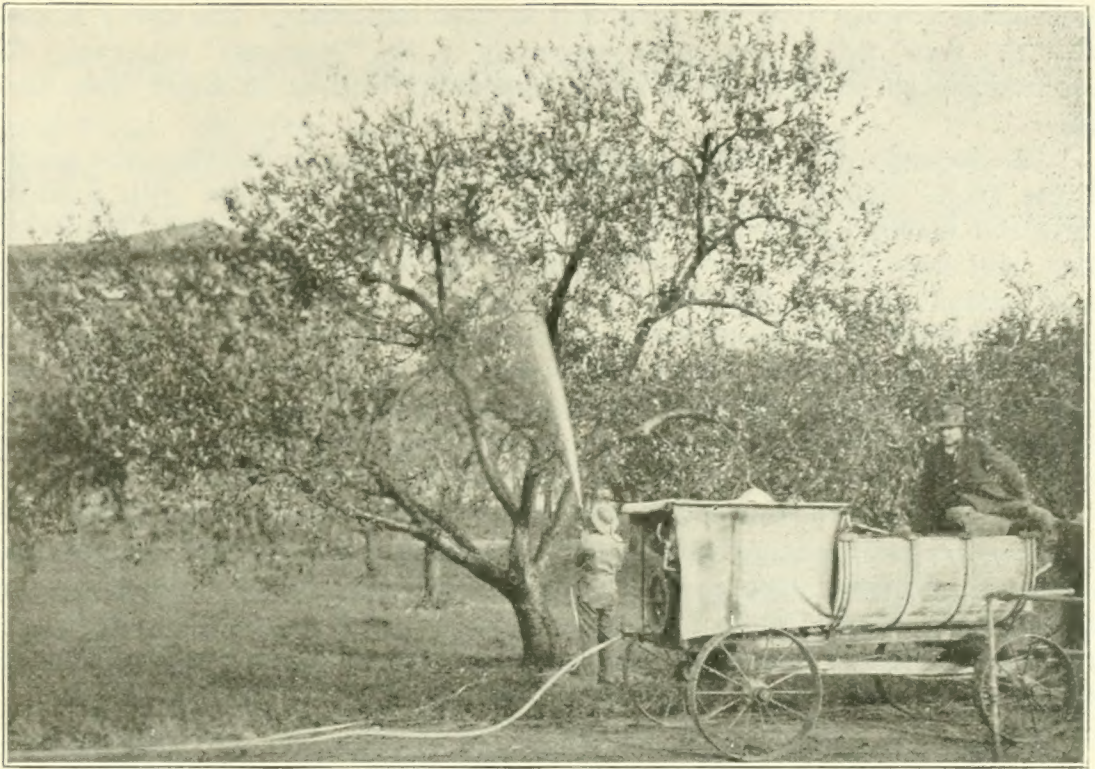
into the spray tank. A little water was usually needed last to bring the tank to the desired level. Where arsenate of lead was combined with the bordeaux it was mixed into solution and added to the spray tank last.

Time of Application.—Special bordeaux sprays for blotch control were applied as follows:

1. Two weeks after petal fall
2. Four weeks after petal fall
3. Six weeks after petal fall
4. Ten weeks after petal fall

Arsenate of lead at the rate of 1 pound powder or 2 pounds paste to 50 gallons was combined with No. 1 and No. 4 for control of codling worms and other biting insects.

The above schedule is designed for a "clean-up" program for badly infected trees. As the disease is brought under control the number of special



Second step in spraying a tree for blotch. The spray is directed upward in the interior. This covers the under surfaces of branches and foliage and completes the covering of the "inside cheeks" of the apples.



Third step in spraying a tree for blotch, the outside is covered by circling the tree in a systematic manner. The branches are sprayed until they are very thoroly covered and drip profusely.

blotch sprays needed can probably be reduced. Observations indicate that the application 2 weeks after the petal fall is most important. The spray 4 weeks after the petal fall is also quite necessary in the "clean-up" program. The last two sprays are very desirable in improving control on susceptible varieties.

The keynote of success in controlling blotch lies in keeping the surface of the fruit, foliage, and growing twigs completely covered with bordeaux while the blotch spores are being spread. No spray, however thoroly applied, will keep blotch from developing on fruit and new growths if put on after spores have alighted and germinated on unprotected surfaces. The spray materials must be on first. Apple blotch spores begin to spread from winter-over cankers soon after petal fall, and continue to be disseminated more or less thruout the summer. They are spread most abundantly during the first 6 weeks following petal fall. During these 6 weeks the young apples enlarge very rapidly and the new growths push out very fast. From 4 to 6 weeks elapse after infection before blotched spots appear on the fruit. Frequent and thoro spraying is therefore necessary to keep new surfaces covered as they grow. The spray program given above was worked out with these facts in mind. Many failures to control blotch are due to delaying the first application too long after the petal fall and by making applications too far apart.

Method of Application.—Some system is necessary in spraying for blotch to insure complete cover of all surfaces. The following method was adopted in demonstration work where the spray gun and power sprayer were used. A similar system could be practiced with rods. The operator first goes to the trunk of the tree and sprays around the interior, directing the spray out and up. He then steps out somewhat and directs the spray to the top of the interior of the tree. Then he steps out beyond the spread of limbs and sprays around the tree from top to bottom in the usual manner. Particular attention is given to covering the new growths in working around the tree. A spray outfit furnishing high pressure is necessary to put the material on the trees as a fine driving mist and give complete cover. A working pressure of from 200 to 300 pounds is desirable.

Other Factors in Blotch Control.—A general thinning-out pruning before spraying season begins will facilitate the blotch spraying. This pruning is to remove dead limbs and many of the more heavily cankered branches, and those that crowd badly. Thick places in the tree, especially in the outer fringe of bearing wood, are thinned to allow sunlight and air to penetrate to all parts of the tree. Such a pruning will allow more thoro spraying with a consequent saving of time, labor, and spray materials.

Frequently badly diseased weak trees, especially old trees, will be helped in their efforts to overcome blotch if fertilized with a quickly available form of nitrogen, such as nitrate of soda or sulfate of ammonia. A bearing tree of average size can profitably use about 5 pounds of nitrate or 4 pounds of sulfate of ammonia. It should be broadcasted on the ground under and out from the drip of the limbs when the trees are in the pink stage before full bloom. This fertilization encourages an abundance of new growth which can be kept free from cankers by spraying and which will gradually build up a healthy fruit spur system.

SOME RESULTS IN DEMONSTRATION ORCHARDS

JAMES CONLEY ORCHARD—CLERMONT COUNTY, 1919

Age of Trees. About 20 years.

Varieties. Principally Ben Davis and Smith Cider.

General Condition. Ben Davis trees in fair vigor. Smith Cider trees weakened considerably by apple blotch infection.

General Treatment. Trees given dormant thinning-out pruning to get rid of dead and diseased wood as much as possible and allow thoro spraying. Trees fertilized with nitrate of soda 5 pounds per tree in pink stage. Dormant spray of lime-sulfur applied at strength 1-7 as buds were breaking. Pre-blossom spray of 4-6-50 bordeaux made in the pink for scab control, followed by petal-fall spray of lime-sulfur 1-40 combined with powdered arsenate of lead 1 pound to 50 gallons.

SPRAY TREATMENT FOR BLOTCH. Two rows running thru the orchard containing 6 Ben Davis and 11 Smith Cider trees taken for the demonstration plot. A typical Ben Davis tree and a similar Smith Cider tree were not given the special blotch spraying as a check on the work. Material used was 3-5-50 bordeaux applied 2, 4, 6, and 10 weeks after petal fall (May 22, June 5, June 19, and July 17). Power sprayer and spray gun used.

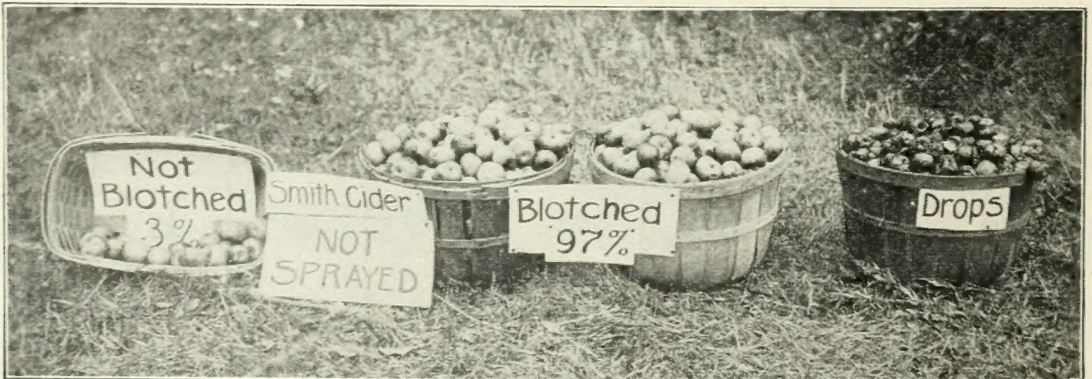
Results. Blotch began making its appearance on the fruit of the check trees about 6 weeks after petal fall. At harvest time, October 9, some tree counts were made and the following data secured on the effectiveness of the spray treatment.

RESULTS OF SPRAY TREATMENT

Variety	Yield picked apples (bushels)	Total apples	Number blotched	Number free	Percent blotched	Percent free	Remarks
Smith Cider (Sprayed for blotch)	13	3664	291	3373	8	92	Apples showing blotch, slightly infected, market- able
Smith Cider (check)	2	647	629	18	97	3	90 % of blotched apples unmar- ketable 580 worth- less drops
Ben Davis (Sprayed for blotch)	8	1364	124	1240	9	91	Nearly all blotched apples market- able
Ben Davis (Not sprayed for blotch)	6½	1463	290	1173	80	20	



A typical Smith Cider tree which was not given the special sprays for blotch in the demonstration at the Conley orchard. This tree received the usual dormant, pre-blossom and petal-fall sprays for the control of scale, scab, worms, etc. The crop of this tree was cut down to 3 bushels of miserable apples by blotch.



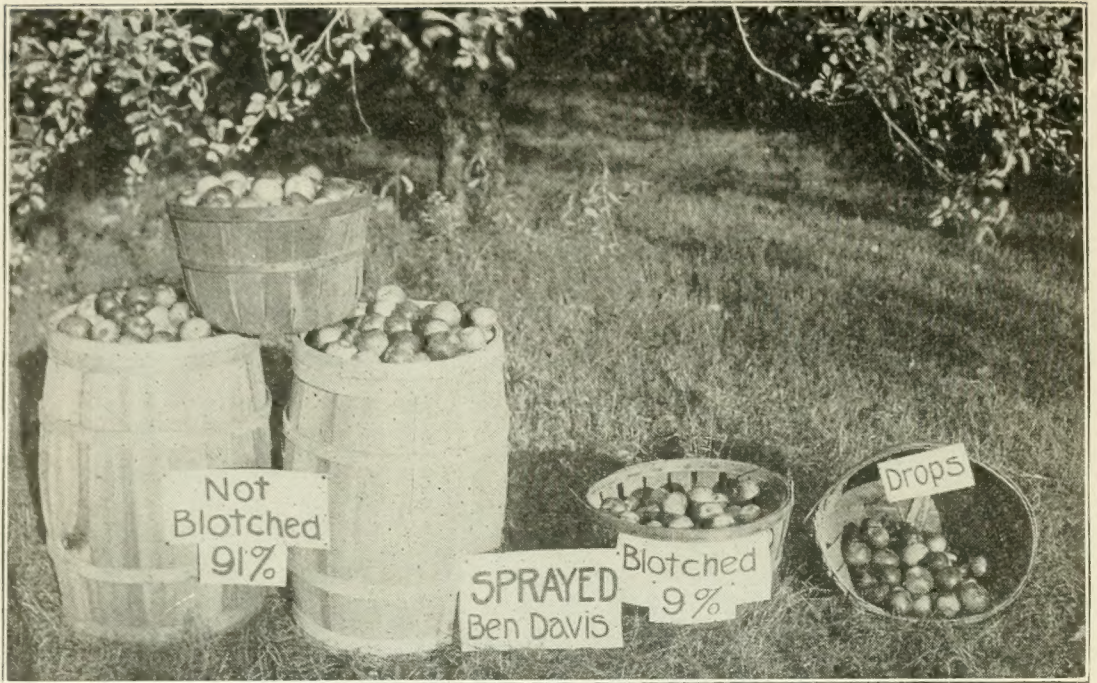
The crop of the Smith Cider tree shown above was 2 bushels of miserable, picked apples and 1 bushel of worthless drops.



A typical Smith Cider tree in the demonstration plot of the Conley orchard which received the special blotch sprays. This tree stood next in the row to the check tree shown opposite. Photographed in October, 1919, just before harvesting when the tree was laden down with 13 bushels of fine fruit.



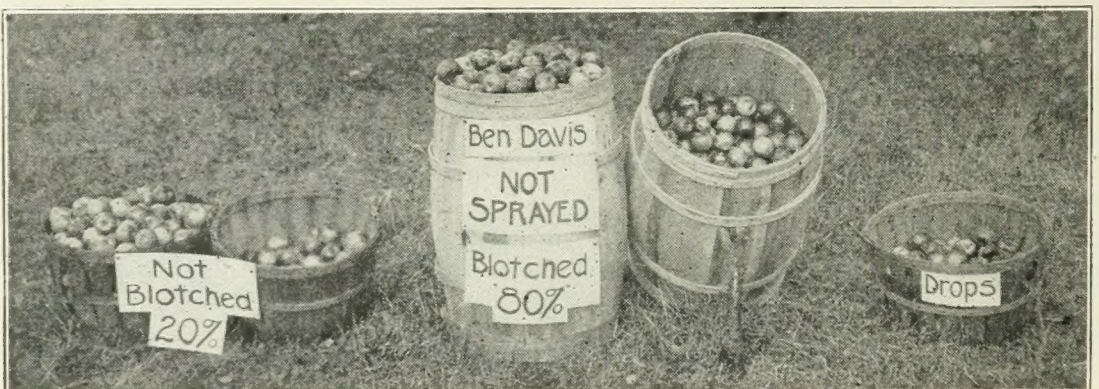
The crop of the Smith Cider tree shown above was all marketable. The 8 percent which are indicated as "blotched," carry but small infections.



The crop of a Ben Davis tree which received the special blotch sprays in the demonstration at the Conley orchard. Yield 8 bushels, of which nearly all of the blotched apples were marketable.

The great difference in yield between the sprayed Smith Cider and the Smith Cider check as compared to the yields of corresponding Ben Davis trees is explained by the fact that Smith Cider is more susceptible to blotch injury than Ben Davis. While the two Smith Cider trees set practically the same crop, the one not sprayed for blotch became so badly diseased that most of its crop was on the ground at harvest time. A large number of the dropped Smith Cider apples from the check tree had mummied so badly on the ground that they had blown away and could not be found under the tree at harvest time. The Ben Davis check tree, while badly diseased, still carried its crop pretty well at harvest time. It carried more apples than the tree sprayed for blotch but yielded a bushel and a half less, due to the dwarfing action of blotch on the development of the fruit.

It is apparent that the blotch first entered this orchard on Smith Cider. These trees soon became seriously cankered and a source of infection to the Ben Davis trees near them.



The crop of a Ben Davis tree not given the special blotch sprays in the demonstration at the Conley orchard. Yield $6\frac{1}{2}$ bushels.

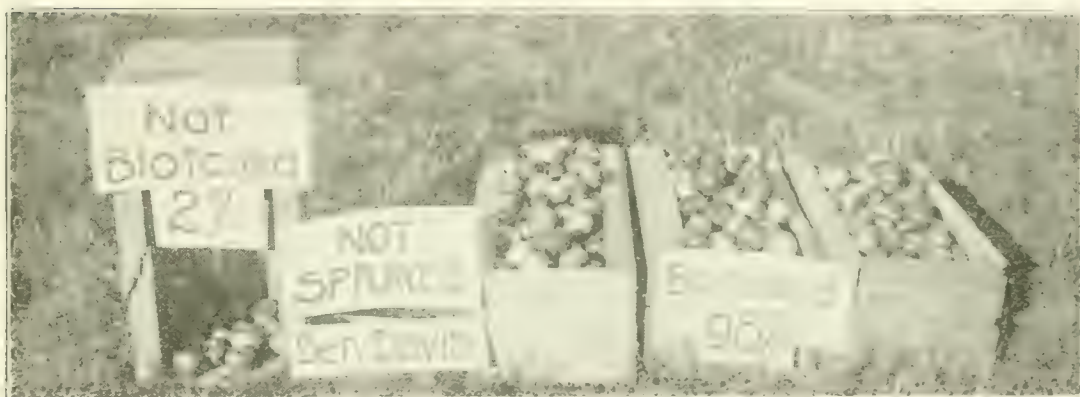
HARVEY PERIN ORCHARD—CLERMONT COUNTY, 1919

Age of Trees. About 30 years.

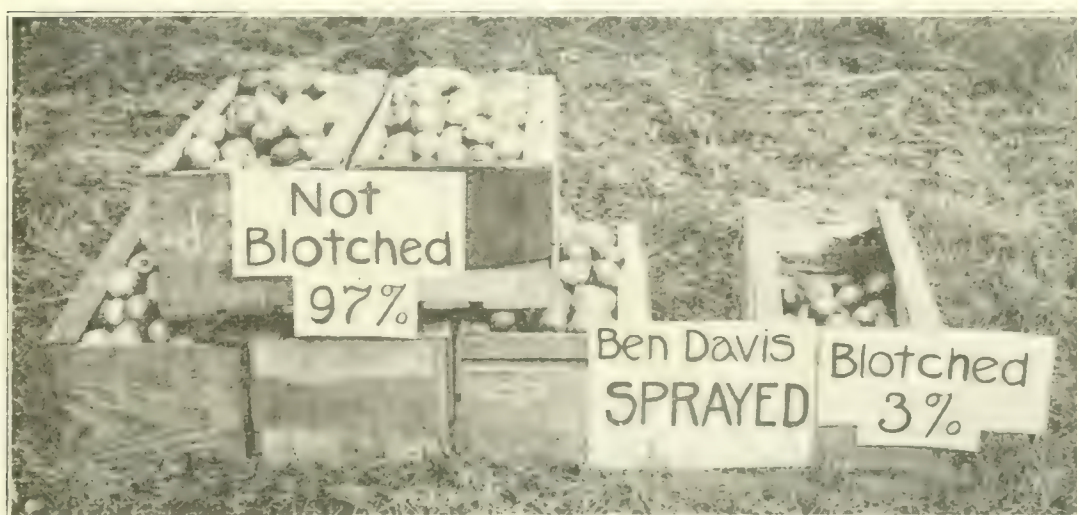
Variety. Ben Davis.

General Condition. Fair vigor. Beginning to show weakened condition thru apple blotch infection.

General Treatment. Trees in sod. Grass cut and let lie. Fertilized with nitrate of soda 5 pounds per tree in the pink stage. Dormant spray of lime-sulfur 1-7 given as buds were breaking. Petal-fall spray of lime sulfur 1-40 combined with arsenate of lead powder, 1 pound to 50 gallons. Trees thick and badly in need of pruning.



A sample crop of picked apples from a Ben Davis tree given no special sprays for blotch in the Perin orchard. Yield 3 bushels and practically all severely blotched.



A crop of picked apples from a Ben Davis tree sprayed for blotch in the Perin orchard. Yield 5 1-3 bushels. For details see account of the demonstration.

SPRAY TREATMENT FOR BLOTCH. An entire row thru the orchard containing 17 trees was given special spraying for blotch. Adjoining row left as check. Bordeaux mixture 3-5-50 was applied 2, 4, 6, and 10 weeks following petal-fall (May 21, June 4, June 18, and July 16). Power sprayer and spray gun used.

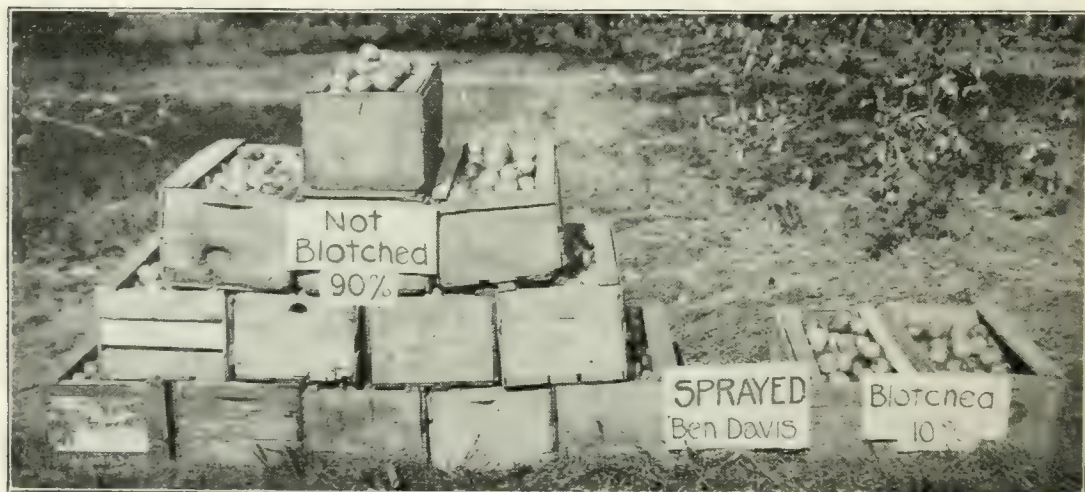
Results. On the check trees, blotch began appearing on the apples June 18, at the time of the 6-weeks spray. At harvest time some individual tree counts were made with the following results:



A Ben Davis tree sprayed for blotch in the Perin orchard. The crop from this tree amounting to $14\frac{3}{4}$ bushels is shown in an accompanying view. Photographed in October, 1919.

RESULTS ON TREES NOT SPRAYED FOR BLOTCH

Variety	Yield picked apples (bushels)	Total apples	Number blotched	Number free	Percent blotched	Percent free	Remarks
Ben Davis	3	878	862	16	98	2	90 percent crop unmarketable
Ben Davis	$3\frac{1}{2}$	976	831	145	85	15	
Ben Davis	6	1470	1082	388	74	26	
Average for Check Trees					83	17	



The crop of picked apples from the Ben Davis tree just shown. Yield $14\frac{3}{4}$ bushels.

RESULTS ON TREES SPRAYED FOR BLOTCH

Variety	Yield picked apples (bushels)	Total apples	Number blotched	Number free	Percent blotched	Percent free	Remarks
Ben Davis	7	1617	442	1175	27	73	All blotched apples but slightly infected and market- able
Ben Davis	8½	1778	320	1458	12	88	
Ben Davis	5 1-3	1510	47	1463	3	97	
Ben Davis	14¾	2959	327	2632	10	90	
Average for Sprayed Trees					14	86	

The trees in the demonstration plot of the Perin orchard were sprayed with considerable difficulty owing to their lack of proper pruning. The fruiting branches had matted together making it tedious and difficult to give thoro spraying. This condition also necessitated the use of an excessive amount of spray material. The spraying could also have been given in half the time had the trees been properly thinned out by judicious pruning beforehand. Nevertheless the demonstration row was the outstanding one of the orchard. The special blotch sprays kept the foliage in splendid vigor. Adjoining rows showed scant foliage after midsummer due to the ravages of "frog eye" leaf spot, apple scab and other diseases which were simultaneously controlled by the special blotch sprays.

H. J. ARNOLD ORCHARD—CLERMONT COUNTY, 1919

Age of Trees. About 30 years.

Varieties. Principally Ben Davis and Smith Cider.

General Condition. Very severe blotch infection on Smith Cider, Ben Davis, and Maiden Blush

General Treatment. Thoro thinning-out pruning given in early spring. Trees fertilized with nitrate of soda at the rate of 5 pounds per tree when in the pink stage. Dormant spray of lime-sulfur 1-7 made as buds were breaking. Pre-blossom spray in pink stage applied with 4-4-50 bordeaux. Petal-fall spray given with lime-sulfur 1-40 combined with powdered arsenate of lead at the rate of 1 pound in 50 gallons.



A crop of picked apples from a Ben Davis tree sprayed for blotch in the Arnold orchard. Yield 11 bushels. A sample of the first satisfactory crop in this orchard since Mr. Arnold bought the orchard in 1915. Blotch had taken practically the entire crop in the four successive years prior to this demonstration. For details see account of the demonstration.

SPRAY TREATMENT FOR BLOTCH. At Mr. Arnold's request bordeaux was used at the rate of 4-4-50, using lump lime. Applications were made 2, 4, 6, and 10 weeks following petal fall (May 21, June 4, June 18, July 16). Applied with power sprayer and spray gun.

Results. This treatment was given the entire orchard of about 50 trees, which produced the first heavy clean crop since Mr. Arnold bought the orchard in 1915. A few tree counts at harvest time gave the following control of blotch. In the records the slightest infection of blotch, classed the apple as "blotched" even tho the spot was of trifling importance.

RESULTS ON TREES SPRAYED

Variety	Yield picked apples (bushels)	Total apples	Number blotched	Number free	Percent blotched	Percent free	Remarks
Summer Rose	9	1905	86	1819	4	96	All blotched apples but slightly infected and market- able
Ben Davis	11	2323	173	2150	7	93	
Smith Cider	4	1111	259	852	23	77	

SUMMARY

1. Satisfactory control of severe cases of apple blotch upon even the most susceptible varieties has been secured the first season by spraying with 3-5-50 bordeaux mixture applied 2, 4, 6, and 10 weeks after petal fall.
2. Special systematic direction of the spray to give complete cover of all growing surfaces of fruit, foliage, twigs, and new growths is essential to satisfactory control. A working pressure of from 200 to 300 pounds is desirable.
3. A thinning-out pruning previous to the spray treatment allows the spraying to be done most thoroly with corresponding control of blotch.
4. Weak trees heavily infected with blotch cankers, are usually benefited by fertilization with nitrogen. About 5 pounds of nitrate of soda per tree applied when the blossoms are in the pink has helped old trees to renew a satisfactory amount of fruiting wood which can be kept free from infection by the special blotch sprays.